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dence that we may feel quite justified in declaring that some error has crept into the classification of the injuries included in the three groups, sprains, cuts and bruises, and miscellaneous, as shown in the table for the year 1894. In short, it is more probable that error exists, either clerical, or arising from unusual professional carelessness in diagnosis, than that percentages of distribution, which have persisted so regularly during the three preceding years, should suddenly change to the extent shown in the table.

It is quite likely that the several accident insurance companies of the country have accumulated material relating to fortuitous events much more extensive than the above, which would yield equally interesting results if subjected to analysis.

There is one point to which it seems worth while to invite especial attention, namely, the confusion which often exists as to the inherent improbability of certain events. Such events are those which, for reasons entirely independent of the probability of their occurrence, have a particular interest. As an illustration, I may refer to the chance of the appearance of a particular hand at whist. Two or three years ago those interested in games with cards were greatly excited by the alleged occurrence of an event in the Boston & Albany railroad station in Boston. It was nothing less than that during the progress of a game of whist played by three railroad conductors and a mail agent, while waiting for the hour of departure of their trains, on taking up the cards after a deal each man found himself in possession of the whole thirteen cards of one suit. The *a priori* probability of such an event is all but infinitely small, and it was thought to be necessary to fortify the account published with affidavits of all the players and also of one or two gentlemen who happened to be watching the game. It probably oc-

curred to few who read this account that the chances against any other particular distribution of the cards were just as great as against this, and that the result of every deal of the cards is just as remarkable as this and as little likely ever to occur again in the lifetime of the players. Indeed, any event of life, when considered in connection with contemporaneous and related events, in all their ramifications, will be found to have *a priori* chances so overwhelmingly against it that it seems impossible that it ever should happen. An 'accidental' death, for example, is an event generally unlikely, but in any specific case enough collateral circumstance and related fact can always be found to render the *a priori* probability of the combination nearly infinitely small. The chances of any man whom you may name meeting his death by falling from the third-story back window of the house belonging to his grandmother on his mother's side, and impaling himself on the point of a cotton umbrella accidentally left wide open in the garden below by the man servant of a gentleman named Witherspoon, temporarily stopping at the nearest inn, to whom he had loaned it on the day before at 2 P. M., in the lull of a thunderstorm which came from the north, are indefinitely small; yet I have been told that a man actually lost his life in just that way, and it is easy to see that the exact repetition of the simplest event in life, with all of its accompanying conditions and relations, would be just as incredible as this.

T. C. MENDENHALL.

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HORTICULTURE AT CORNELL.

IN response to a request from the editor of SCIENCE, a brief outline of the purposes and methods of the work in horticulture at Cornell University is here given. This is the more willingly given because no full statement has been made of the capabilities

which the subject of plant cultivation offers as a means of education. Horticulture is ordinarily taught in a technical or professional way, as a direct training for the intending farmer or gardener; but the purpose at Cornell has been much different, and it may be said broader than this. The subject seems to be capable of adding much to the value of a course of liberal academic training. In the older fields of education such an outline as is here proposed might seem to be presumptuous, but in view of the novelty of the present subject and the awakening interest in it the sketch may perhaps be pardoned.

MATERIAL EQUIPMENT.

Before proceeding to the more important aspects of the subject the reader may desire to know something of the facilities for the teaching of horticulture at Cornell. The material equipment is not large. It is exceeded in several other institutions in the country. If landscape gardening be added to the subject it must be said that the equipment and facilities in this theme are practically nothing. The horticultural department comprises two diverse yet cognate lines of effort, the teaching and the research. The latter is commonly known, now that the experiment station idea is widespread, as experiment work. The same lands and glass houses serve the two purposes. About ten acres of hilly and uneven land, upon which a miscellaneous but not large collection of fruits is growing, are allotted to the department. Something over an acre of this area is set aside for flower growing. The glass houses comprise eight structures, all connected, with an aggregate glass area of less than 9,000 square feet. These are plain, cheap structures, of which the total original cost, including heaters, was about \$4,000. They are of the forcing-house type, and are adapted to the growing of the ordinary

commercial crops, such as winter melons, cucumbers, tomatoes, lettuce, beans, carnations, chrysanthemums and the like. There are no museum collections, except a very valuable and rapidly growing herbarium of cultivated plants, in which there are now about 9,000 specimens. The small equipment is admirably supplemented in some directions by the orchards and gardens of the State, for it is the purpose to rely much upon the actual condition of horticulture in the Commonwealth as a basis of experiment and research. There are many experiments of importance which are now going forward on the farms of New York State; and whenever the investigation is of such a character that it can be conducted satisfactorily off the University premises it is in some respects better for the alienation, because it spreads the work before a larger constituency and ensures an accurate measure of its practical worth. But for teaching purposes these remarks will not apply.

THE MOTIVE OF INSTRUCTION.

The teaching of horticulture is of very recent origin. There are only two or three professorships of horticulture, uncombined with related subjects, in the whole country. The teaching of both agriculture and horticulture is commonly conceived of as a training for actual participation in these occupations. Most of the agricultural colleges are essentially training schools, at least so far as these subjects are concerned, and it is incontrovertible that they have exercised a powerful influence for the betterment of rural life. The Cornell teaching aims not so much to make farmers as to educate farmers' sons and daughters. In other words, its fundamental idea is to give those students who anticipate a rural life such a breadth of training as will put them into touch and sympathy with the traditions of education, with all the larger movements of the day, and which shall enable

them at the same time to understand the fundamental reasons of their own occupations. There is less attempt to apply the teaching upon the University farm than to instill a desire to master the underlying principles of agriculture. There is, therefore, no compulsory labor system any more than there is in the teaching of engineering or archæology. The student can ill afford the time while at college to perform mere manual labor. He must give all his strength to the acquirement of knowledge, and even then he finds four years all too short in which to grasp the essential principles of the complicated rural pursuits. Teaching is done by class exercises and by laboratory work, as it is in all other scientific and technical subjects at the present day. If the student hears a lecture upon the philosophy of the rotation of crops he also goes for a walk with the professor over the fields of the University farm and of adjoining lands and there observes the good and bad points of farm management. Or, if he hears a lecture upon winter tomatoes he also goes with the instructor, or alone, from day to day, and studies the tomatoes as they grow under glass. The sum of education as it applies to rural affairs is comprised in the two words, judgment and management; and the student needs to have his mind opened by thinking upon economics, language, history and general science quite as much as upon some of the particular subjects with which he is to deal in a more intimate way. The student should be a citizen before he is a farmer.

If the student once masters principles he is able of his own resources to apply them. Yet many mature students come to us—some of them graduates—who have been taught the applications, the methods of doing farm work, but who are greatly ignorant of the fundamental principles upon which these applications rest. From all these remarks it is apparent that much of

the teaching does not lead directly, of itself, to better farm practice, but it aims to educate the student. Its effect upon the student is certainly salutary. As soon as he comes to learn that agricultural practice rests upon certain great laws, the operation and control of which are largely in his own hands, he becomes enthusiastic and develops a deep and abiding love for rural life. This result is not obtained by the mere training school.

HORTICULTURE AS A SCIENCE.

Speaking more specifically of horticulture, it may be said that the subject has merit as a science. A single illustration will suffice, without touching upon all the immediate science of cultivation and of vegetable physiology. The one greatest conception before the human mind at the present time is evolution. Data are demanded from every source. Upon the organic side, and within the realm of readily observable phenomena, the two greatest sources of facts in support of the hypothesis of evolution are paleontology and horticulture. My reader will no doubt at once accuse me of unseemly assurance in daring to associate horticulture with a science of such importance. Paleontology derives its chief interest from the fact that it spreads the broken pages of the old book of life before our eyes. Horticulture shows the movements in operation. Six thousand and more species of plants are widely cultivated, and most of them are broken up into many forms under the touch of the operator. Some species have produced thousands of distinct forms. These forms are recorded, and of many of them the exact methods and reasons of the genesis are known. A vast panorama of varieties, or 'incipient species,' as Darwin called them, is passing daily before us. Men talk of the probable influence of climate upon plants; the horticulturist can cite you definite cases by the

score showing influence of climate and in which there are no elements of conjecture. They speculate upon the transmission of acquired characters; the horticulturist knows that they may be transmitted, and he can furnish the proofs. Men want to know what may be the influence of selection, of struggle for life, of the change of soil or moisture or any other feature of environment; the horticulturist cites you to exact cases, before your very eyes, for these are the tools with which from the earliest time he has wrought and moulded the vegetable world at his will. You ask that a new species be created; the horticulturist has done it time and again, and he has the proof of botanical classification—which was made in ignorance of the origin of the given form or species—to show that the form really does rank as a good species; or if you will not accept the opinion of botanists or the testimony of your eyes, as to the real specific distinctness of the new form, the horticulturist will show you a hundred species of cultivated plants of which no one knows the original forms, because the present type is so unlike the original one that we have not yet been able to connect the one with the other. Twenty thousand new forms is a very conservative estimate of the number which the horticulturist has produced by changes in the conditions of life and by his efforts of selection. He, therefore, is of all men the one to talk about evolution, for he has his knowledge first-hand from nature. Paleontology is the Egyptian hieroglyphic; plant culture is the last revised edition of the record of the life process.

COURSES OF INSTRUCTION.

The courses of instruction now offered are twelve: The evolution of cultivated plants; the literature of horticulture; the botany of cultivated plants; the propagation of plants; pomology, or fruit raising;

olericulture, or vegetable gardening; floriculture; greenhouse construction and management; the theory and practice of the spraying of plants; landscape gardening; instruction in handicraft; investigation for advanced students.

Some of these courses are given as seminars; that is, the students and instructor meet informally in a small room and discuss the subject of the day. Let us take the course upon the literature of horticulture as an illustration. There are no bibliographies of horticultural writings and no collections of books which intend to be complete. All this is proof that horticulture has had few students in this country. This course is the only one of its kind ever given, so far as we know. The University library has a fair collection of horticultural books, and the writer's collection of American horticultural literature is the most complete in its line. From these collections the course draws its supplies. The following subjects have been taken up for discussion so far this term:

The herbals; Roman literature; literature of landscape gardening; European grape literature; American grape literature; French literature; early American literature; German literature; current American literature; English literature; periodical literature.

The chief writings illustrating these various topics are taken to the seminary room, where they are freely discussed, the teacher acting more as a leader of the discussion than as an instructor.

Students frequently lead these discussions. This is particularly true of the seminary on greenhouses, now in progress. In this course the following subjects have been under review this term: Evolution of the greenhouse; side walls and foundations; roofs; interior arrangements; methods of heating; ventilation; styles of houses for particular purposes; glass and glazing; watering; pots and soils.

An important part of the teaching lies in the working out of special problems by the students. Some of the results of this work are worth publication, and a number of them have found record in the bulletins of the experiment station. Some topics now under consideration by horticultural students are these:

The influence of the mechanical texture of soils upon plants under glass; the evolution of the cultivated begonias; the relation of pollen bearing to the vigor of the plant; the relation of flower bearing to the vigor of the plant; the cultivated species of oxalis; the physics of greenhouse roofs; influence of crossing upon the resulting fruit; can acquired characters persist? the evolution of the current chrysanthemums; the philosophy of the watering of plants; the year's rewards in sweet peas; the viburnums as horticultural subjects.

The study of some of these subjects extends over a period of two or three years, and an effort is made to place all available material within the student's reach. The general plan of study is the monograph. In a study of the canna there were brought together nearly 300 varieties; of sweet peas, 120 varieties; of chrysanthemums, from 100 to 200 varieties. It is thus possible to arrive at a comprehensive judgment of the merits and evolution of the varieties, and the educational value of such work is great.

All this is work which demands a considerable maturity of judgment and much training on the part of the student. The reader will now want to know who these students are. In the first place, it should be said that they are few. This teaching is new and it has not yet secured for itself any recognition amongst the traditions of education. It is one of the most recent developments of the modern impulse which aims to carry the educational method into every realm of thought and industry. It must be of slow growth; it must overcome much

prejudice, and it must prove its right to exist. The roster of a single class, that in the evolution of cultivated plants and which is by no means the largest one, may satisfy the reader's curiosity. Fourteen students are at present taking the course. One is a professor of horticulture in a New England State institution and holds the degree of Master of Science; another holds the degree of Bachelor of Arts from the University of Michigan; another is a graduate of the Michigan Agricultural College; two are graduates of Cornell, one of them from the College of Mechanical Engineering and who has a love for rural life as well as for mechanical pursuits; one is the son of a leading Eastern seed merchant, who expects to enter his father's business; one has been a florist for fifteen years and has had training in two universities; two are Japanese; the others are special students who expect to follow rural occupations. Most of these men are fitting themselves for teachers or experimenters and have already reached years of maturity.

Aside from this class of students there are others direct from the farms who are crowding much special and technical work into a brief time. They find their places chiefly in the applied courses, as pomology, propagation of plants and the like, and at work in the gardens and forcing houses. They return to the farms when they have done with their college work. The total number of persons receiving instruction of the horticultural department during the year has been between sixty and seventy for the past two years. These are *bona fide* agricultural students, having come up to the University for the specific purpose of receiving instruction in the College of Agriculture.

EXTENSION TEACHING.

The teaching of agriculture is now indelibly associated with the distribution of the published results of research or experi-

ment work and with the giving of instruction before farmer's meetings. The itinerant teaching has been connected chiefly with the Farmers' Institute movement, which is now firmly established as a governmental enterprise in most of the Northern States. In New York, however, the movement has ripened into a custom of holding itinerant schools which shall be devoted to the particular interests of the locality in which they are held. Itinerant dairy schools have been held in this State, off and on, for a number of years. The first horticultural school of this type ever held was convened in Fredonia, Chautauqua County, New York, in the Christmas holidays of last year (1894). It extended over a period of four days. The underlying conception of the school was to give instruction in some of the fundamental principles of soil tillage and to awaken the enthusiasm of the participants. A system of observation teaching was introduced. A session was opened, for example, by putting leafless twigs into the hands of the students and requiring them to look at the specimens. It is needless to say that many original and novel observations were made, and that curiosity and enthusiasm reached a high pitch when some one stumbled on to the fact that the buds are arranged in geometrical order! These simple observation lessons have always been a source of delight to the participants in these classes, and they have probably resulted in quite as much ultimate good as the more didactic teaching. The students who enroll themselves in these schools are men and women of various ages, comprising persons who love rural life. The enrollment has run from 30 to 120 persons, but the teaching, having been given to the most intelligent persons in the community, exerts a very wide and abiding influence.

As a matter of contemporary interest and of history, the program of this first horticulture school is here inserted :

WEDNESDAY, DEC. 26, 1894.

2 P. M.

1. Announcements.
2. Observation upon *Twigs*.
3. *How Plants live and grow*; with demonstrations with the microscope: W. W. ROWLEE, Assistant Professor of Botany in Cornell University.

7 P. M.

4. *An Analysis of Landscapes*; with stereopticon views: L. H. BAILEY.

THURSDAY, DEC. 27.

9:30 A. M.

5. Observations upon *Fruit Buds*.
6. *The Nursery*; discussion upon the propagation of plants, illustrated with the operations and nursery-grown specimens: NELSON C. SMITH, Geneva.

2 P. M.

7. Observations upon *Seeds*.
8. *A Brief of the Evolution of Plants*; origination of varieties; philosophy of domestication and pruning: L. H. BAILEY.

7 P. M.

9. *The Geological History of Soils*; with stereopticon views: R. S. TARR, Assistant Professor of Dynamic Geology and Physical Geography in Cornell University.

FRIDAY, DEC. 28.

9.30 A. M.

10. Observation upon *Leaves*.
11. *Chemistry of the Grape and of Soils*: G. C. CALDWELL, Professor of Chemistry in Cornell University.

2 P. M.

12. Observation upon *Flowers*.
13. *Theory of Tillage and Productivity of Land*: I. P. ROBERTS, Director of the College of Agriculture, Cornell University.

7 P. M.

14. *What are Fungi?* Considered with special reference to the grape, with stereopticon views: E. G. LODEMAN, Instructor in Horticulture in Cornell University.

SATURDAY, DEC. 29.

9.30 A. M.

15. Observation upon *Fruits*.
16. *Commercial Grape Culture in Chautauqua County*; considered in various aspects: by S. S. CRISSEY, Fredonia; G. SCHOENFELD, Westfield; J. A. TENNANT, Ripley.

2 P. M.

17. Observation upon *The Apple*.
 18. Continuation of No. 16.
 19. General Question Box.
 20. Final exercises.
- "This is probably the first school of its kind devoted to horticulture in this country. With no pre-

cedents to guide us we shall probably make mistakes, but we shall all do our best. It will always be a pleasant memory that we have participated in a pioneer movement.

"The day exercises will aim at specific instruction in particular subjects. The evening exercises will be popular illustrated lectures.

"Everyone is invited to attend the various exercises. Persons have the privilege of enrolling themselves as students for the purpose of receiving personal aid upon the points under discussion. At the close of each day's exercise the students will be questioned upon the subjects. This questioning is not pursued for the purpose of ascertaining the student's knowledge of the exercise, but to elucidate the subject under discussion. During this exercise, also, the student has the privilege of freely asking questions upon the topic under consideration. It is expected that the instructors will not be interrupted with questions during the course of the exercise.

"Each day session will be opened with a *lesson upon observation*. Students will be given specimens, as indicated in the program, and ten minutes will be allowed for examination of them. The students will then be questioned as to what they have seen.

"Students should provide themselves with notebook and pencil.

"Roll will be called immediately upon the hour set for meeting.

"Printed synopses of all the day lectures will be distributed to students.

"While most of the instruction deals with fundamental principles, special applications will be made to the grape whenever possible."

About a dozen of these schools, of longer or shorter duration, have now been held. They always awaken a widespread influence. Frequently the residents of the village or city attend them in the interest of nature study. In Jamestown, a city of 20,000 people, the high school was dismissed upon one occasion to enable the teachers to attend an observation upon flowers. It is certain that these schools accomplish more direct good for the farming interests by means of this type of teaching than they could by simply specifying a set of rules which the farmer shall follow, or by giving up the time to so-called practical information. This teaching not only awakens the farmer himself, but it also interests all

other citizens in his work. All this was never better illustrated than in a session at the Jamestown school devoted to insects. If one is to talk to a rural audience about insects it is presumed, of course, that he will devote himself to methods of destroying them. Not so here, however. Insects were passed around for observation, and *papier maché* models were in the hands of the instructor. The teacher soon had the audience interested in the insect itself. The students looked through the bug's eyes, heard as it heard, felt as it felt, and thereby came into sympathy with living things. For nearly two hours over one hundred people listened to this exposition in rapt attention, and it is safe to say that every student went away in a wholly new frame of mind respecting the objects which he had always been taught to dread.

EXPERIMENT OR RESEARCH WORK.

Aside from all this extension teaching, the experiment station publications must not be overlooked. Each State and Territory is in recent years issuing these periodical bulletins of instruction and information, and the effect is even now seen in the beginnings of an uplift in the agricultural population of which the outcome, at the end of the present generation, will be momentous and stupendous. Probably no government has ever inaugurated a movement which reflects more wisdom and statesmanship upon its promoters than this experiment station enterprise of the United States. It probes the very essence of national prosperity and lays a foundation of intelligence and inspiration which all the convulsions of time cannot overturn.

At Cornell the experiment station work has attempted to consider fundamental subjects, or those of abiding interest, rather than those of mere transient or local importance. Our horticultural inquiries have lain along three lines: the study of the

fruit interests of the State; the study of the forcing-house industry, particularly in relation to winter vegetables and the commercial flowers; studies in the systematic botany of cultivated plants. Many of the results have been published in bulletins of the experiment station. In the forcing industry we need soon to take up the growing of winter fruits, such as nectarines, peaches, cherries, grapes and the like, subjects for which we at present have no equipment. The influence of the electric light upon plants has been a subject of study for five consecutive years.

My reader now wants to know if the farmer appreciates it all. For New York State, I answer, Yes! A thousand times, Yes! Those who have kept no track of the farming population can have no appreciation of the almost volcanic awakening which is now taking place. Old methods are breaking down, old and cherished customs are crumbling, and in the confusion of the break-up and the transition the weak are going to the wall; but the best will survive! Rural life is the life of the future. Its inspiration and support are the irrevocable laws which are an inborn and integral part of the constitution of nature and of society.

The old and deserved derision of 'book-farming' is only a memory. Good teaching finds a response everywhere. In fact, the response is the measure of the teaching. The college professor is not only welcome, but is eagerly sought in almost every rural community. There is direct proof of this interest in New York State. The funds upon which we, at Cornell, are able to hold these schools and to make many investigations upon the farms were given by the State Legislature in response to a spontaneous demand from the people without any aid or abetting by teachers or experimenters.

UNSUPPLIED DEMANDS.

In purely horticultural directions the

demands for better facilities of instruction are urgent. One of the chief of these demands is in floriculture and other glass-house industry. This is the refinement of rural industry, and it becomes prominent with the progress and refinement of the state. Floriculture is preëminently adapted to the employment of women, both upon the side of plant growing and upon the side of decoration and adornment. The value of the floricultural product in the last census year was over \$26,000,000, and 2,000 women were then employed in the business. The enumeration of floriculture in the eleventh census, which was the first one ever made in this country, is said to have been suggested by Mrs. Porter, wife of the Superintendent of the Census, and originated in her desire to find employment for the many women who applied to her. All this great and growing floricultural and glass-house industry has no school which it may call its own, and none which is giving any specific attention to the subject. It is doubtful if any other industry of equal extent in the country is so completely without the means of education. The only way to become a florist now is to 'serve time' in an establishment. This the women, at least, can not do; but if there were a school where, in connection with good educational facilities, the art and practice and science of floriculture were taught, women as well as men could find an attractive outlet for their ambitions. The time cannot be far remote when some institution will honor itself with a school of floriculture.

In conclusion, the reader should be reminded that it is a fundamental concept of modern society that educational facilities shall be extended to every person. There must be a general intellectual uplift. Almost every profession and class of persons have been reached by this widening educational impulse, but the farmer and the horti-

culturist have been touched the least of all. These rural pursuits are particularly difficult to reach, not because the people who follow them are unwilling to learn, but because most of the instruction has been out of sympathy with them and unadapted to them. The more difficult the problem, the greater is the need of solving it. The rural industries must be enlightened by instruction which shall be both educational and useful. Nothing less can satisfy the demands of humanity and patriotism.

L. H. BAILEY.

ON SCHOOL HYGIENE.*

HYGIENE is applied physiology. It is the science and art of promoting and preserving health, which we take to mean the greatest energy of each part, compatible with the greatest energy of the whole organism. School hygiene as an art is concerned with all measures that science and experience have shown to be helpful and efficacious for securing the normal growth and development of pupils and the normal activity of teachers, under the conditions incident to school life. Nearly one-quarter of the total population of the United States is at present subject to the conditions of school life, or, in other words, is engaged in the sedentary occupation of schooling. Of our school population over 96% is found in elementary schools, and over 18% is found in cities. Urban conditions at their best are less favorable than rural conditions for rearing full-grown, vigorous, healthy children. City-bred children of school age in America—at least in the six great cities on the Atlantic seaboard—are less favorably situated than their contemporaries in certain European cities, it would appear.

Thus the death rate per 1,000 living at

*Abstract of report of Chairman of Committee on School Hygiene—read before child-study section of National Education Association, at Denver meeting, July, 1895.

the age-period 5–15, which is the healthiest decade of life among civilized men, is less in London than in Brooklyn, Philadelphia, New York, Washington and Baltimore, or in Boston, whose death rate is higher than in any of the cities named; while Berlin has a lower death rate than any of these cities, except Washington and Baltimore. The mortality from diphtheria among children of school age—and from consumption among female school teachers—is markedly greater in Boston than in any other of the American cities named above. No class of wage earners in Boston, so far as the mortality rates, analyzed by occupation, of the U. S. Census Bureau go, has so high a death rate from consumption as women school teachers, excepting marble and stone cutters. The fact that Boston is the only one these six cities which habitually neglects to wash her schoolhouse floors and corridors from year to year and decade to decade is not without significance.

It cannot be denied that municipal sanitation and school hygiene are more highly organized and successfully administered in the leading cities of Europe than in the leading cities of America. Indeed, school hygiene had no place or standing among the arts and sciences in America. There appears to be no department of public health so miserably endowed, so incompletely organized, or so wellnigh universally neglected by publicists, scientists and publishers as school hygiene. Without resorting to foreign books, periodicals and official reports, it is quite impossible for the student to inform himself as to the nature and results of the investigations and experiments made during recent years for the improvement of the health of the school population on the continent of Europe.

The public schools are organized, maintained and regulated by the State, which clearly owes it to itself to take adequate measures to prevent the school population